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PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE
in its capacity as elected Office

Date of mailing (day/month/year) 09 April 2001 (09.04.01)	Applicant's or agent's file reference W/M/106
International application No. PCT/IB00/01048	Priority date (day/month/year) 29 July 1999 (29.07.99)
International filing date (day/month/year) 27 July 2000 (27.07.00)	
Applicant SEITZ, Michael, Walter	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:23 February 2001 (23.02.01)☐ in a notice effecting later election filed with the International Bureau on:2. The election ☒ was☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Pascal Piriou Telephone No.: (41-22) 338.83.38
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REPLACED BY
ANNEX 2

PATENT COOPERATION TREATY

PCT

REC'D 21 SEP 2001

WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference PA129347/PCT	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IB00/01048	International filing date (day/month/year) 27/07/2000	Priority date (day/month/year) 29/07/1999
International Patent Classification (IPC) or national classification and IPC B05B7/22		
Applicant METALSPRAY INTERNATIONAL LC et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.
☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 23/02/2001	Date of completion of this report 19.09.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Narcisi, C Telephone No. +49 89 2399 8915 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB00/01048

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-9 as originally filed

Claims, No.:

1-11 as received on 11/08/2001 with letter of 01/08/2001

Drawings, sheets:

1/3-3/3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB00/01048

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-11
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-11
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-11
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

Concerning point I

In the subject matter of claim 1 as submitted on 11.08.2001 the feature has been omitted implying that the guides are "arranged to direct the feedstock wires to the point of intersection so that they define an angle of between 45° and 90° between them". This feature is considered as an essential feature of the invention as originally defined in claim 1 and in the description (see pages 2,9) and no indication is given in the application that also angles outside the mentioned range could be used. Hence the present preliminary examination report does not take into account the mentioned omission and is therefore based on the assumption that this omission has not occurred.

It is however noted that such an omission, if not remedied in the regional phase, would eventually lead to refusal of the application before the EPO.

Concerning point V

The subject matter of claim 1 appears to meet the criteria of novelty, inventive step and industrial applicability. It is directed to a thermal spray apparatus for producing corrosion resistant or hard coatings on a substrate as known from WO-A-98/00574 (D1). The invention differs from this prior art in that the nozzle is formed from first and second body halves, each defining a portion of the throat which constitutes the nozzle.

The combination of the features of claim 1 are not known or rendered obvious from the cited prior art. Document FR-A-1 130 352 discloses a thermal spraying device comprising two body halves, but wherein each half portion includes a separate nozzle.

Dependent claims 2-11 relate to various embodiments of the invention according to claim 1 and therefore likewise meet the above criteria.

Concerning point VII

The claims do not include any reference signs (Rule 6 PCT) and the description has not been adapted to the subject matter of the amended claims, which necessarily leads to a lack of consistency and clarity.

CLAIMS:

1. Thermal spraying apparatus comprising a nozzle defining a throat having an inlet and an outlet and a gas flow path which is aligned with the axis of the throat, so that gas under pressure can be supplied to the inlet; at least first and second guides arranged to guide respective feedstock wires via the inlet towards a point of intersection in or adjacent an end of the throat; a power supply arranged to be connected to the feedstock wires to cause an arc in the throat between the wires; and a supply of compressed air arranged to supply air to the throat, the guides being arranged to direct the feedstock wires to the point of intersection so that they define an angle of between 45° and 90° between them.
2. Thermal spraying apparatus according to claim 1 wherein the guides are arranged so that the angle defined between the feedstock wires is approximately 60°.
3. Thermal spraying apparatus according to claim 1 or claim 2 wherein the nozzle may be formed from first and second body halves, each defining a portion of the throat.
4. Thermal spraying apparatus according to claim 3 wherein the guides comprise respective bores formed in the body halves and each intersecting the portion of the body half defining a respective portion of the throat, each bore being inclined relative to the axis of the throat.
5. Thermal spraying apparatus according to claim 4 wherein the guides include inserts receivable in the respective bores, each insert having an aperture therein through which a feedstock wire can pass, and

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having an inclined end face shaped complementally to the shape of the throat.

6. Thermal spraying apparatus according to claim 4 wherein the respective bores intersect locating cavities, inserts being receivable in the locating cavities so that they abut feedstock wires passing through the respective bores.
7. Thermal spraying apparatus according to claim 6 wherein the inserts are polygonal in section and define planar faces each having a locating formation for engagement with a feedstock wire in use.
8. Thermal spraying apparatus according to claim 7 wherein the inserts are square in section and define planar, rectangular faces with a groove formed in at least one face for engagement with a feedstock wire in use.
9. Thermal spraying apparatus according to claims 5 to 8 wherein the inserts comprise copper or copper/tungsten.
10. Thermal spraying apparatus according to any one of claims 3 to 9 wherein the body halves are preferably conductive, with a terminal or contact on each body half for connection to the power supply.
11. Thermal spraying apparatus according to claim 10 wherein the body halves are mounted on a non-conductive head which holds the body halves in a spaced-apart condition.
12. Thermal spraying apparatus according to any one of the preceding claims wherein the throat is rectangular in cross section.

- 1 -

THERMAL SPRAYING EQUIPMENT

BACKGROUND OF THE INVENTION

THIS invention relates to thermal spraying equipment and to a thermal spraying method for producing corrosion resistant and/or hard coatings on a substrate.

International patent application no. WO 98/00574 describes a thermal spraying method and apparatus of the above general kind.

It is an object of the invention to provide a method and apparatus which is a development of the known method and apparatus.

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SUMMARY OF THE INVENTION

According to the invention there is provided thermal spraying apparatus comprising a nozzle defining a throat having an inlet and an outlet and a gas flow path which is aligned with the axis of the throat, so that gas under pressure can be supplied to the inlet; at least first and second guides arranged to guide respective feedstock wires via the inlet towards a point of intersection in or adjacent an end of the throat; a power supply arranged to be connected to the feedstock wires to cause an arc in the throat between the wires; and a supply of compressed air arranged to supply air to the throat, the guides being arranged to direct the feedstock wires to the point of intersection so that they define an angle of between 45° and 90° between them.

Preferably, the guides are arranged so that the angle defined between the feedstock wires is approximately 60° .

The nozzle may be formed from first and second body halves, each defining a portion of the throat. Typically the throat is tapered between the inlet and the outlet.

The guides may comprise respective bores formed in the body halves and each intersecting the portion of the body half defining a respective portion of the throat, each bore being inclined relative to the axis of the throat.

The guides may include inserts receivable in the respective bores, each insert having an aperture therein through which a feedstock wire can pass, and having an inclined end face shaped complementally to the shape of the throat.

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Alternatively, the respective bores may intersect locating cavities, inserts being receivable in the locating cavities so that they abut feedstock wires passing through the respective bores.

The inserts may be polygonal in section and define planar faces each having a locating formation for engagement with a feedstock wire in use.

Preferably, the inserts are square in section and define planar, rectangular faces with a groove formed in at least one face for engagement with a feedstock wire in use.

The inserts may comprise copper or copper/tungsten.

The body halves are preferably conductive, with a terminal or contact on each body half for connection to the power supply.

The body halves are preferably mounted on a non-conductive head which holds the body halves in a spaced-apart condition.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an exploded view of a first embodiment of a spray head of thermal spraying apparatus according to the invention;

Figure 2 is a pictorial view of the apparatus of Figure 1;

Figure 3 is a rear end view of the apparatus of Figure 1;

Figure 4 is a section on the line 4-4 in Figure 3;

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Figure 5 is a partial exploded view of a second embodiment of a spray head of the apparatus; and

Figure 6 is a sectional view of the second embodiment of the spray head.

DESCRIPTION OF EMBODIMENTS

The apparatus illustrated in Figures 1 to 4 comprises a thermal spraying head which is connected in use to a source of compressed air or nitrogen by means of a hose 10, and to a high current power supply 12 in use.

The general principle of operation of the apparatus is substantially similar to that described in the abovementioned international patent application no. WO 98/00574, the contents of which are incorporated herein by reference.

The spray head of the apparatus comprises first and second conductive body halves 14 and 16 which are machined from aluminium alloy and which are mounted on a non-conductive head 18 which can, for example, be moulded or machined from a suitable plastics material such as PTFE.

As shown in the exploded view of Figure 1, the body halves 14 and 16 are attached to the head 18 hingedly by means of pins, which assist in assembly of the head and in correct location of the body halves with respect to one another. An outer sleeve 56 of tough plastics material such as nylon holds the body halves in position and is located positively by a pin 58.

The front face of the head has a circular central portion 20, at the centre of which is an outlet 22 of a nozzle which has an inlet 24, and a cylindrical throat 26 extending between the inlet and the outlet. The throat is tapered

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from the inlet to the outlet such that it has an inlet diameter of 8mm and an exit diameter of 8.5mm.

Cavities 28 and 30 are machined into the respective body halves 14 and 16, and define respective inclined bores 32 and 34 which intersect with respective grooved portions 36 and 38 of the body halves which define the throat 26, at an angle of approximately 30° to the axis X-X of the throat, so that the included angle between the two bores 34 is 60°.

Locatable within each bore is a copper insert 40, the inserts 40 having ends 42 which are shaped complementally to the grooved surfaces 36 and 38 defining the throat of the nozzle, so that when the inserts are in position in the bores 34, their ends 42 are flush with the surface of the throat. A bore 44 is formed in each insert which is sized to receive a metal feedstock wire 46 and to make electrical contact with the wire as the wire passes through the insert and into the throat 26.

In the prototype apparatus, the feedstock wires 46 were directed to a point of intersection at the outer end of the throat 26 essentially coinciding with the outlet 22 and the central axis X-X of the throat. In some applications, it may be desirable to move the point of intersection outside the throat, although it has been found in practice that it is generally preferred for the point of intersection to be within the throat.

Electrical terminals 48 and 50 on the respective body halves 14 and 16 are provided for connection of heavy duty conductors 52 and 54 which connect the body halves to the power supply 12, and which thus pass current to the feedstock wires 46 via the body halves and the copper inserts, causing an arc at the point of intersection of the feedstock wires in the throat. In the prototype apparatus of the invention, the power supply 12 was a constant voltage source operating at approximately 42 to 48 volts (compared with

- 6 -

approximately 32 to 36 volts in the case of conventional apparatus). The arc current was between 150 Amperes and 300 Amperes and the gas pressure at the entrance 2 to 5 bar (g), typically 4 bar.

Figures 5 and 6 illustrate a second embodiment of a thermal spraying head according to the invention. The second embodiment is to a large extent similar to the first, and Figure 5 therefore illustrates only a single conductive body half 114, which corresponds to the body half 14 of Figure 1. The body half 114 mates with a complementary body half 116 (see Figure 6) and the halves are assembled to a non-conductive body in the same way as in the first embodiment.

The main difference between the first and second embodiments is that in the latter case, each body half defines a rectangular slot or cavity 118 which receives a contact tip in the form of a removable insert 120. A relatively small bore 122, which is larger in diameter than the diameter of the feedstock wires 124, extends from an upstanding head portion 126 of the body half 114, exiting the head portion 126 at the base thereof, just above the bottom of the cavity 118, and extending further through an end portion 128 of the body half as best seen in the sectional view of Figure 6. The insert 120 has a central groove 134 machined in each of its four adjacent faces, so that the grooves effectively run around the body of the insert. The function of the insert is described in more detail below. As in the first embodiment, the alignment of the bores 122 and the central groove 134 in the insert 120 is such that the feedstock wires 124 intersect at a point just within or just beyond the end 130 of a throat 132 defined between the two body halves.

The throat 132 in this embodiment is a tapered square/rectangular section channel, rather than a conical bore, since this is easier to machine and a round orifice for the outlet is not a prerequisite. The entrance to the throat is 6 mm by 6 mm, with the exit being 6 mm by 7 mm (rectangular).

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The insert 120 serves the same purpose as the copper inserts 40 of the first embodiment, and typically comprises copper or copper/tungsten. A through bore 136 extends through the insert from side to side, and is provided to facilitate storage of the inserts. In the prototype, the insert was approximately 20 mm in length in the direction of the through bore 136, and the faces thereof were 12 mm square with the grooves 134 being approximately 1mm deep. Dimples 138 are provided on each face on either side of the central groove, and serve as locators for locking balls or grub screws 140 as shown in Figures 5 and 6.

As mentioned above, the feedstock wires 124 lie within the grooves 134 in use (see Figure 6), with the insert providing the force which directs the feedstock wire to its point of intersection, thus providing sufficiently good electrical contact between the feedstock wire and the insert.

The above described inserts have a number of advantages over the tubular inserts 40 of the first embodiment. Firstly, each insert has four wear surfaces, so that it need only be rotated through 90 degrees to present a fresh surface. This means that the life of the insert is relatively long. It has been found that this insert does not clog as easily as is the case with drilled-hole inserts. The insert is easy to manufacture, and is also easily fitted into the spray gun head from the front thereof.

As described in the abovementioned International patent application, the pressure and volume of the gas supplied to the interior of the nozzle are preferably adjusted to cause sonic or choked gas flow within the throat prior to generation of an arc, so that the generation of an arc within the throat has the effect of generating supersonic flow within or just beyond the exhaust end of the nozzle, which would otherwise not be attainable. The resultant high flow velocity results in very fine atomisation of the molten feedstock particles

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and very high particle speeds as the particles are emitted from the nozzle towards a substrate.

It has been found that by using a flow of gas which is sonic or supersonic and positioning the arc in the area of supersonic or sonic flow, the most effective results are obtained.

Due to the very high temperature of the arc (typically 4000°C) the arc rapidly heats and drastically expands the gas entering the arc. This rapid expansion effectively acts as a gas source in the flow field, effectively blocking the flow of gas through the arc. Due to this blockage effect, the gas tends to flow around the "obstruction", similarly to the way water flows around a concrete pillar of a bridge.

When a supersonic gas flow exists, the gas flowing towards the "obstruction" (the arc) is not "aware" of the arc until it actually enters the arc zone and the gas is thereby forced into the arc region. The resulting high pressure, high flow situation results in very fine atomisation of the molten feedstock. Thus, where a supersonic basic gas flow is used, the arc can be positioned anywhere along the throat, up to and including the exit region of the throat and just beyond it. In the case of a supersonic output spray, the exhausting flow has a diamond shaped supersonic flow field structure.

The feedstock wires 46 can be conventional solid wires, but it has been found that the use of cored wires comprising a tubular metallic body containing a cermet powder, together with the use of nitrogen or another suitable inert gas, provides excellent results. The cermet material, typically an agglomerated and sintered mix of metal and carbide, tends to improve the deposition of carbide material from the thermal spray method, as the hard carbide material is contained within a metal binder. Use of pure nitrogen or another suitable inert gas protects the atomised metal feedstock particles

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from oxidation, significantly improving the quality of the coating produced.

It has been found that utilising relatively short spray distances between the outlet of the nozzle and the substrate to be coated, preferably less than 100 mm and down to as little as 5 mm, further reduces the formation of oxides which detrimentally effect the quality of the coating. In prior art devices, short spraying distances can lead to overheating of the substrate, but due to the very high gas flow through the spray device of the invention, the gas jet has a cooling effect, preventing overheating.

It is believed that the use of a relatively steep angle of intersection between the feedstock wires of at least 45°, and typically 60°, compared with the conventional angle of intersection of approximately 30°, ensures that the ends of the feedstock wires at the point of generation of the arc are more stable in the high velocity gas stream in the throat, and that the atomisation of the molten metal resulting from the arc is more uniform due to the smaller exposed surface cross section of the feedstock wires. In this regard, the design of the wire guides so as not to protrude into the throat and therefore not to disturb the gas flow in the throat is also important.

CLAIMS:

1. Thermal spraying apparatus comprising a nozzle defining a throat having an inlet and an outlet and a gas flow path which is aligned with the axis of the throat, so that gas under pressure can be supplied to the inlet; at least first and second guides arranged to guide respective feedstock wires via the inlet towards a point of intersection in or adjacent an end of the throat; a power supply arranged to be connected to the feedstock wires to cause an arc in the throat between the wires; and a supply of compressed air arranged to supply air to the throat, the guides being arranged to direct the feedstock wires to the point of intersection so that they define an angle of between 45° and 90° between them.
2. Thermal spraying apparatus according to claim 1 wherein the guides are arranged so that the angle defined between the feedstock wires is approximately 60°.
3. Thermal spraying apparatus according to claim 1 or claim 2 wherein the nozzle may be formed from first and second body halves, each defining a portion of the throat.
4. Thermal spraying apparatus according to claim 3 wherein the guides comprise respective bores formed in the body halves and each intersecting the portion of the body half defining a respective portion of the throat, each bore being inclined relative to the axis of the throat.
5. Thermal spraying apparatus according to claim 4 wherein the guides include inserts receivable in the respective bores, each insert having an aperture therein through which a feedstock wire can pass, and

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having an inclined end face shaped complementally to the shape of the throat.

6. Thermal spraying apparatus according to claim 4 wherein the respective bores intersect locating cavities, inserts being receivable in the locating cavities so that they abut feedstock wires passing through the respective bores.
7. Thermal spraying apparatus according to claim 6 wherein the inserts are polygonal in section and define planar faces each having a locating formation for engagement with a feedstock wire in use.
8. Thermal spraying apparatus according to claim 7 wherein the inserts are square in section and define planar, rectangular faces with a groove formed in at least one face for engagement with a feedstock wire in use.
9. Thermal spraying apparatus according to claims 5 to 8 wherein the inserts comprise copper or copper/tungsten.
10. Thermal spraying apparatus according to any one of claims 3 to 9 wherein the body halves are preferably conductive, with a terminal or contact on each body half for connection to the power supply.
11. Thermal spraying apparatus according to claim 10 wherein the body halves are mounted on a non-conductive head which holds the body halves in a spaced-apart condition.
12. Thermal spraying apparatus according to any one of the preceding claims wherein the throat is rectangular in cross section.

1/3

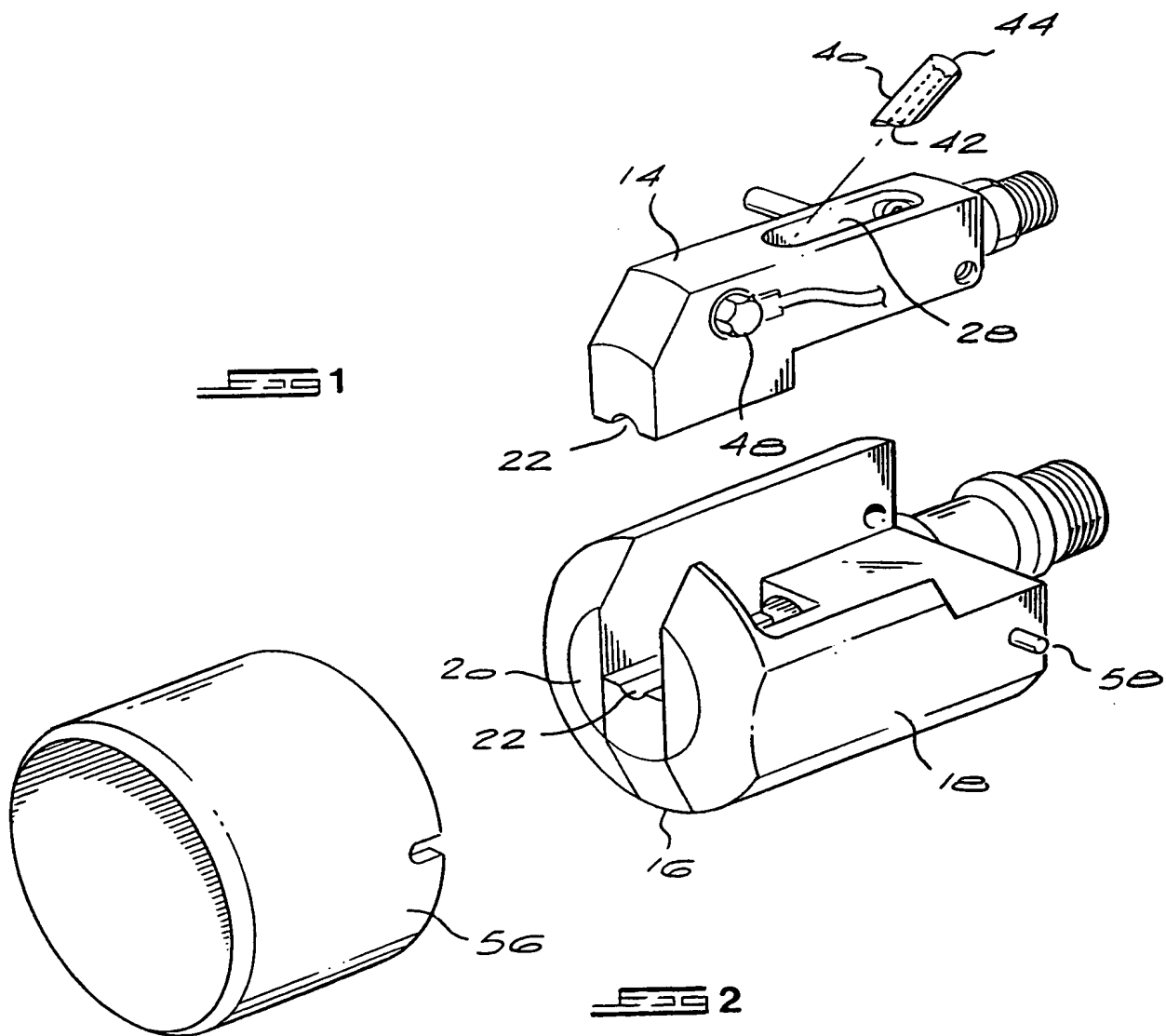
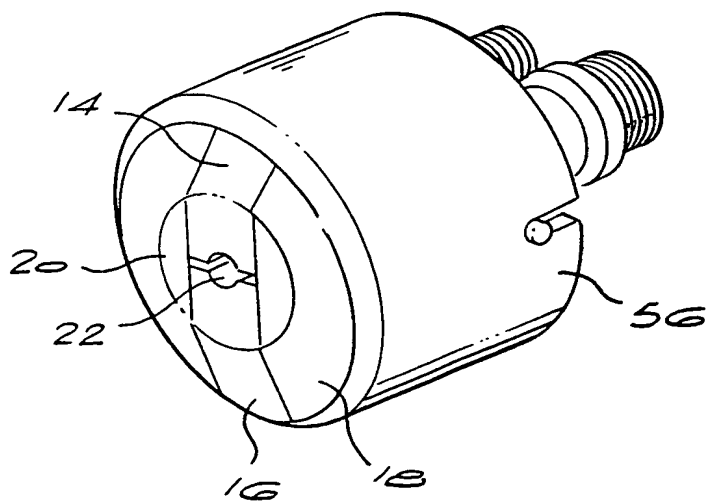
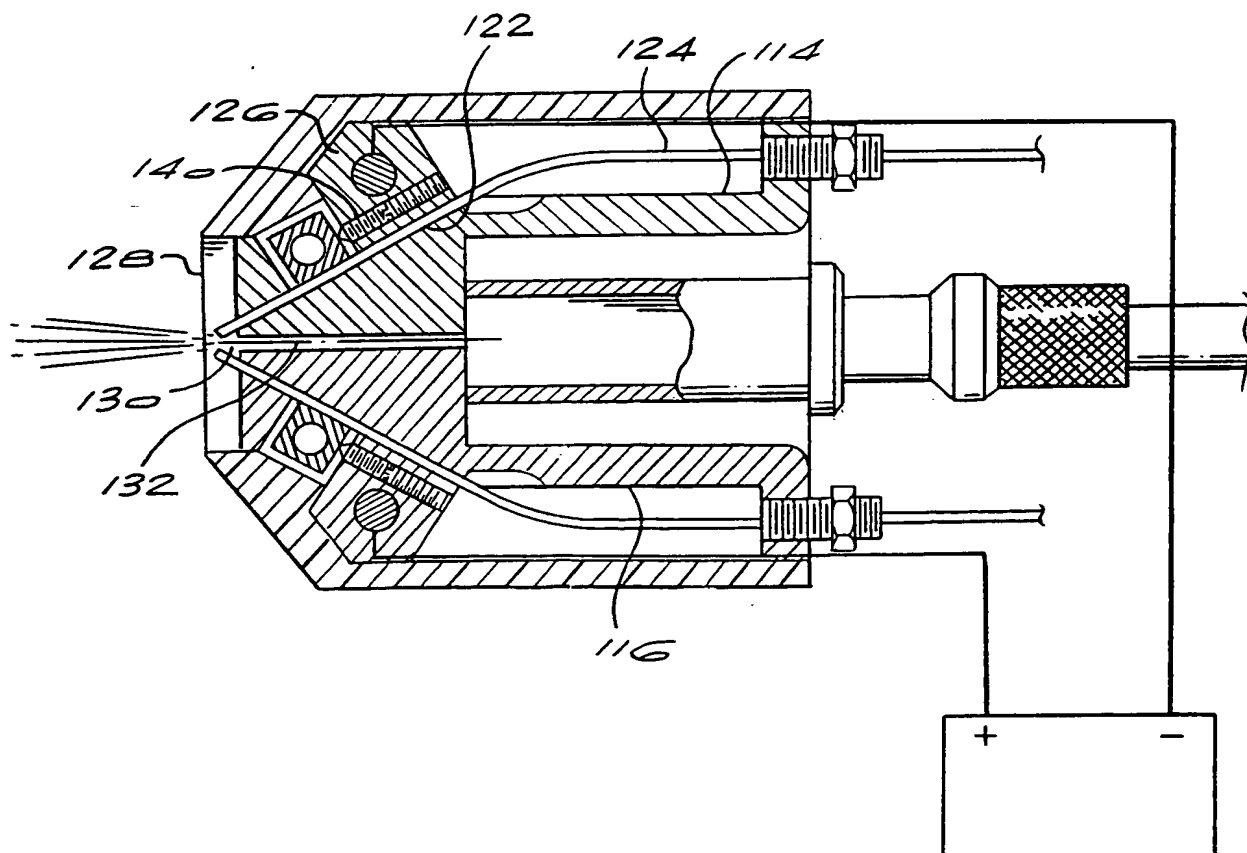
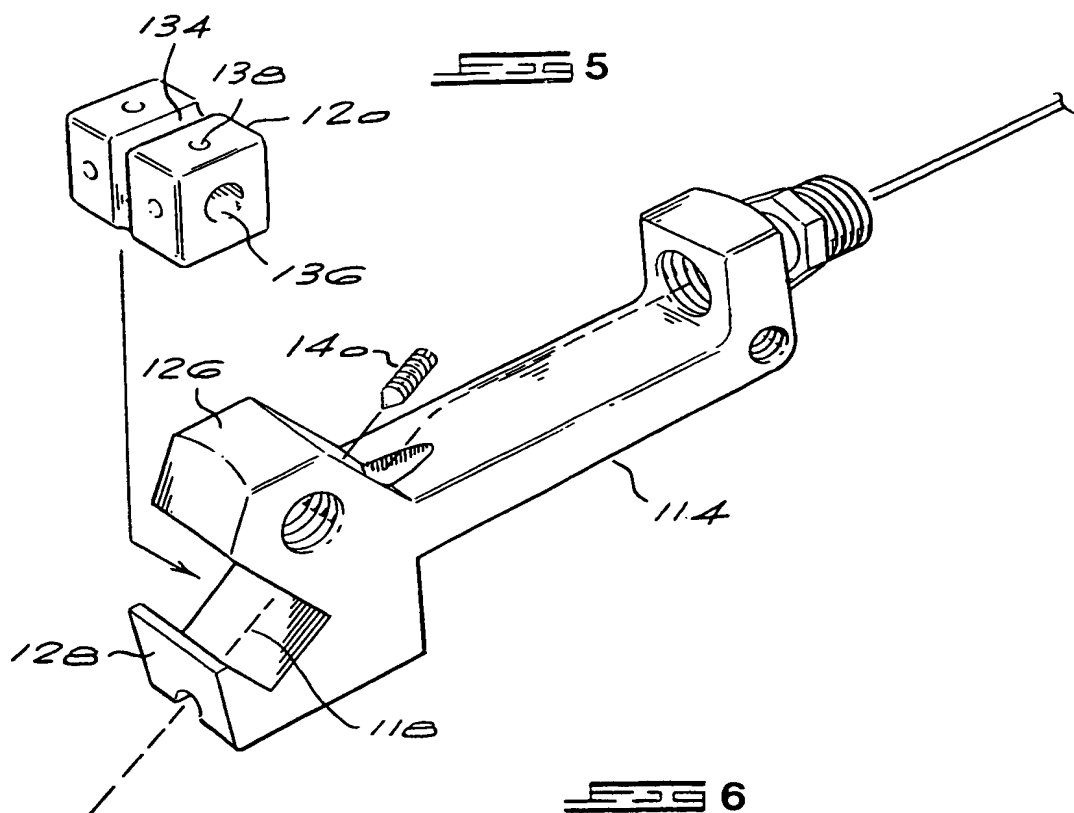


FIG 2



3/3



INTERNATIONAL SEARCH REPORT

International Application No.

PC1/IB 00/01048

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B05B7/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B05B C23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 00574 A (METALPLUS PROPRIETARY LIMITED ; DYER ALISON MARGARET (ZA); SEITZ MI) 8 January 1998 (1998-01-08) cited in the application page 6, line 18 - page 7, line 5	1,2
A	FR 1 130 352 A (MEYER) 5 February 1957 (1957-02-05) page 1, right-hand column, line 30 - line 36	3

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"G" document member of the same patent family

Date of the actual completion of the international search

10 October 2000

Date of mailing of the international search report

17/10/2000

Name and mailing address of the ISA

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Authorized officer

JUGUET, M

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IB 00/01048

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9800574 A	08-01-1998	AT 192510 T	15-05-2000
		AU 3269097 A	21-01-1998
		CA 2259190 A	08-01-1998
		CN 1226287 A	18-08-1999
		DE 69701877 D	08-06-2000
		DE 69701877 T	05-10-2000
		EP 0907760 A	14-04-1999
		NO 986162 A	19-02-1999
FR 1130352 A	05-02-1957	NONE	

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference W/M/106	FOR FURTHER ACTION <small>see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.</small>	
International application No. PCT/IB 00/ 01048	International filing date (day/month/year) 27/07/2000	(Earliest) Priority Date (day/month/year) 29/07/1999
Applicant METALSPRAY INTERNATIONAL LC et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

6

☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB 00/01048

Box III TEXT OF THE ABSTRACT (Continuation of Item 5 of the first sheet)

The abstract is modified as follows:

line 2: after "throat" insert "(132)";

line 3: after "wires" insert "(124)".

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 00/01048

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B05B7/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B05B C23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 00574 A (METALPLUS PROPRIETARY LIMITED ; DYER ALISON MARGARET (ZA); SEITZ MI) 8 January 1998 (1998-01-08) cited in the application page 6, line 18 - page 7, line 5	1,2
A	FR 1 130 352 A (MEYER) 5 February 1957 (1957-02-05) page 1, right-hand column, line 30 - line 36	3

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

10 October 2000

Date of mailing of the international search report

17/10/2000

Name and mailing address of the ISA

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Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

JUGUET, M

INTERNATIONAL SEARCH REPORT


Information on patent family members

International Application No

PCT/IB 00/01048

Patent document cited in search report		Publication dat	Patent family member(s)	Publication dat
WO 9800574 A		08-01-1998	AT 192510 T	15-05-2000
			AU 3269097 A	21-01-1998
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			CN 1226287 A	18-08-1999
			DE 69701877 D	08-06-2000
			DE 69701877 T	05-10-2000
			EP 0907760 A	14-04-1999
			NO 986162 A	19-02-1999
<hr/>				
FR 1130352 A		05-02-1957	NONE	
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PATENT COOPERATION TREATY

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Entered	
Draw file	(Y) N

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

<p>To:</p> <p>Carstens, M. SPOOR & FISHER PO Box 41312 2024 Craighall AFRIQUE DU SUD</p>	<div style="border: 2px solid black; padding: 5px; display: inline-block;"> SPOOR & FISHER 2001 -09- 26 </div> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr><td>SEEN</td></tr> <tr><td>MAIL</td></tr> <tr><td>INPROMA</td></tr> <tr><td>ENTERED BY</td></tr> </table>	SEEN	MAIL	INPROMA	ENTERED BY
SEEN					
MAIL					
INPROMA					
ENTERED BY					

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT
(PCT Rule 71.1)

<p>Date of mailing (day/month/year) 19.09.2001</p>			
<p>Applicant's or agent's file reference PA129347/PCT</p>		<p>IMPORTANT NOTIFICATION</p>	
<p>International application No. PCT/IB00/01048</p>	<p>International filing date (day/month/year) 27/07/2000</p>	<p>Priority date (day/month/year) 29/07/1999</p>	
<p>Applicant METALSPRAY INTERNATIONAL LC et al.</p>			



1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

<p>Name and mailing address of the IPEA/</p> <div style="text-align: center; margin-top: 20px;">  </div> <p>European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465</p>	<p>Authorized officer</p> <p style="font-size: 1.2em; font-weight: bold;">BON, L</p> <p>Tel. +49 89 2399-2961</p> <div style="text-align: right; margin-top: 20px;">  </div>
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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PA129347/PCT	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IB00/01048	International filing date (day/month/year) 27/07/2000	Priority date (day/month/year) 29/07/1999
International Patent Classification (IPC) or national classification and IPC B05B7/22		
Applicant METALSPRAY INTERNATIONAL LC et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 4 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 23/02/2001	Date of completion of this report 19.09.2001
Name and mailing address of the International preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Narcisi, C Telephone No. +49 89 2399 8915 <div style="text-align: right;">  </div>

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB00/01048

I. Basis of the report

1. With regard to the elements of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):
- Description, pages:

1-9 as originally filed

Claims, No.:

1-11 as received on 11/08/2001 with letter of 01/08/2001

Drawings, sheets:

1/3-3/3 as originally filed

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the International application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/IB00/01048**

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims 1-11
	No: Claims
Inventive step (IS)	Yes: Claims 1-11
	No: Claims
Industrial applicability (IA)	Yes: Claims 1-11
	No: Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/IB00/01048

Concerning point I

In the subject matter of claim 1 as submitted on 11.08.2001 the feature has been omitted implying that the guides are "arranged to direct the feedstock wires to the point of intersection so that they define an angle of between 45° and 90° between them". This feature is considered as an essential feature of the invention as originally defined in claim 1 and in the description (see pages 2,9) and no indication is given in the application that also angles outside the mentioned range could be used. Hence the present preliminary examination report does not take into account the mentioned omission and is therefore based on the assumption that this omission has not occurred.

It is however noted that such an omission, if not remedied in the regional phase, would eventually lead to refusal of the application before the EPO.

Concerning point V

The subject matter of claim 1 appears to meet the criteria of novelty, inventive step and industrial applicability. It is directed to a thermal spray apparatus for producing corrosion resistant or hard coatings on a substrate as known from WO-A-98/00574 (D1). The invention differs from this prior art in that the nozzle is formed from first and second body halves, each defining a portion of the throat which constitutes the nozzle.

The combination of the features of claim 1 are not known or rendered obvious from the cited prior art. Document FR-A-1 130 352 discloses a thermal spraying device comprising two body halves, but wherein each half portion includes a separate nozzle.

Dependent claims 2-11 relate to various embodiments of the invention according to claim 1 and therefore likewise meet the above criteria.

Concerning point VII

The claims do not include any reference signs (Rule 6 PCT) and the description has not been adapted to the subject matter of the amended claims, which necessarily leads to a lack of consistency and clarity.

129347/PC

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
8 February 2001 (08.02.2001)

PCT

(10) International Publication Number
WO 01/08810 A1

(51) International Patent Classification⁷: B05B 7/22

(21) International Application Number: PCT/IB00/01048

(22) International Filing Date: 27 July 2000 (27.07.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
99/4887 29 July 1999 (29.07.1999) ZA

(71) Applicant (for all designated States except US): MET-
ALSPRAY INTERNATIONAL LC [US/ZA]; 9 Telford
Street, 2093 Industria (ZA).

(72) Inventor; and

(75) Inventor/Applicant (for US only): SEITZ, Michael, Wal-
ter [ZA/ZA]; 17 Kompas Crescent, Quellcrina, 1724 Rood-
epoort (ZA).

(74) Agents: CARSTENS, Mark, Jonathan et al.; Spoor and
Fisher, P.O. Box 41312, 2024 Craighall (ZA).

(81) Designated States (national): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ,
DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR,
HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR,
LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ,
NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM,
TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

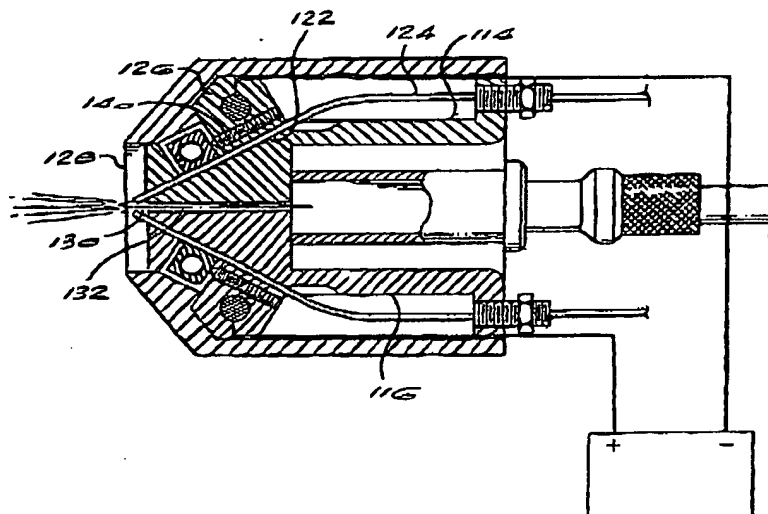
(84) Designated States (regional): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW). Eurasian
patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM). European
patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,
IT, LU, MC, NL, PT, SE). OAPI patent (BF, BJ, CF, CG,
CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— With international search report.

For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: THERMAL SPRAYING EQUIPMENT



(57) Abstract: Thermal spraying apparatus comprises a spray head defining a nozzle with a throat (132) through which gas under pressure can be supplied. First and second guides are provided to guide feedstock wires (124) towards a point of intersection in or adjacent an end of the throat, preferably at an angle of between 45 and 90 degrees. The gas is forced through the throat at high pressure, preferably at a pressure sufficient to cause supersonic flow, thereby generating a finely atomised spray of molten feedstock material. The feedstock guides can take the form of drilled tubular inserts, or inserts with grooves which are received in cavities in body halves of the spray head.



WO 01/08810 A1

INTERNATIONAL SEARCH REPORT

International Application No.

PC1/IB 00/01048

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B05B7/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B05B C23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 00574 A (METALPLUS PROPRIETARY LIMITED ; DYER ALISON MARGARET (ZA); SEITZ MI) 8 January 1998 (1998-01-08) cited in the application page 6, line 18 - page 7, line 5	1,2
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"E" earlier document but published on or after the international filing date

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"B" document member of the same patent family

Date of the actual completion of the international search

10 October 2000

Date of mailing of the international search report

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Name and mailing address of the ISA

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Fax: (+31-70) 340-3016

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PC/IB 00/01048

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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INTERNATIONAL SEARCH REPORT

International Application No.

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- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Fax: (+31-70) 340-3016

Authorized officer

JUGUET, M

INTERNATIONAL SEARCH REPORT

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